

Virtual Reality Application in a Crisis Scenario Model

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Weather changes, ecological and terrorist threats, increased mobility of the population, cross-border activities, structural changes of the wealth are actual trends in our modern world. The new risks, threats and crises which arise nowadays require modern knowledge based instruments in order to predict, to avoid, to manage and to decrease the impact of these events. These modern instruments are developed on the basis of the experience regarding a category of crises and rely on modern information technologies which offer the necessary edge.

Legal aspects regarding the methods to deal with crises

There are three directions regarding the legal support which is offered for the management of risks, emergencies and crises: national law, NATO concepts and EU directives.

In the national law system, the management of emergencies framework is offered by the Law 481 / 2004 which refers to Civil Protection. According to this law, "The civil protection is a component of the national security system and it represents an integrated group of specific actions, measures and organizational, technical, operative tasks which have a humanitarian character and for the public information, the tasks being organized and fulfilled according to this law, *the aim being the prevention and the minimization of the risks of disasters*, the protection of the population, of the goods and of the environment against the negative effects of the emergency situations and wars, and the operative elimination of their effects, and of the assurance of the conditions for the survival of the affected people."

The main ideas in the law are:

- the national law system imposes the undertaken of specific measures based on the emergency management studies;
- the stipulated activities include all the population;
- there must be done documents regarding the planning of the preparation of the civil protection;
- the Ministry of Education and Research together with the General Office

for Emergency Situations will establish the themes and the practical activities regarding the education for the civil protection which will be included in the curricula and in the out-school activities;

- the national law is completed with the stipulations of the international laws and treaties signed by Romania.

Security and the crises management is one of the basic tasks of the NATO organization. In 2004 NATO became an associated member of the "ENVSEC - Environment & Security Initiative" through its own "Public Diplomacy Division". The NATO Scientific Committee offers financial support to the ENVSEC initiative through its own programme "Security through Science". The aim of the programme is to apply science to solve problems in order to offer security, stability and solidarity among nations. The research areas are "Defense Against Terrorism", "Countering Other Threats to Security" and "Partner-Country Priorities". In the list of priority research areas there can be found the following topics:

- *environmental security;*
- *disaster forecast and prevention;*
- human and societal dynamics (new challenges for global security, economic impact of terrorist actions, risk studies, management of science, science policy, security-related political science, etc)

The support mechanism consist of several types of grants, one of them being the "SFP - Science for Peace" grants dedicated to the collaboration in multi-year applied R&D pro-

jects in Partner or Mediterranean Dialogue countries.

At European level the Seveso II directive is dedicated to the risk management, the practical aspects being based onto the preventive principle: "The community has done significant efforts to reach a high level of protection of the environment, of the people, of the health of the animals and vegetation, among others. In most of the cases, the measures which make possible the fulfillment of this objective may be based of adequate scientific basics. Nevertheless, when there are obvious reasons to worry that different threats may affect the environment or the people, the health of the animals and of the vegetation, and when simultaneously, the available data make impossible the detailed evaluation of the risk, the preventive principle was adopted from the political point of view, as a strategy of the risk management in different domains." (European Commission, 2000). The objectives of the Seveso II directive are:

- the *prevention of the major risks of accidents*;
- the *elaboration of plans to minimize the consequences of such accidents*.

On 2nd February 2007, the European Commission issued a proposal regarding a directive which states the minimum penalties for a series of acts of pollution, such as:

- the illegal emission of some polluting agents;
- the illegal transport of the waste substances;
- the traffic with the animals belonging to the endangered species.

For this kind of situations, the directive stipulates convictions with at least 5 years in prison, 750000 euros fines for the people who have done serious polluting acts, which caused the death or the injury of a person of significant deterioration of the air, land, water or vegetation in a given area.

To conclude, national law and international directives and treaties state that the crises management and the risk management are compulsory and there must be undertaken measures of prevention. The basic idea is "it is cheaper to prevent, rather to deal with a

crisis". Beside training, the prevention methods rely on multidisciplinary and interdisciplinary studies in order to create advanced models which offer accurate and reliable data which are used for predictions and in the decision making process. Most of the studies are based on computer approaches, the computer being used for both studies and as an alarming instrument, in crisis on-going conditions. An actual obvious trend is the use of the modern technologies, such as virtual reality to create instruments for the crises management.

Brief info regarding the oilspill accidents

In the last 30 years there were several marine oilspill accidents which had serious consequences.

Amoco Cadiz accident produced on 16/03/1978 has created a 230000 tones crude oil leak and the damage consisted of 85,2 million dollars.

On 06/07/1988 on the Piper Alpha off-shore platform was produced an explosion which caused the death of 167 people out of 240 onboard at that time. The root cause was the malfunction of a pump because of the bad maintenance.

In 1989 the Exxon Valdez oiltanker struck the Bligh reef which caused a major oilspill spreaded on 1900 kilometers of the coast. The financial losses consisted of 3.5 billion dollars.

In January 1991 the first eco-terrorism action took place in Iraq. An oilspill of more than one million tones was produced, which is the largest oilspill accident in the history. The toxic waste was a threat for the health for several years.

On 14/12/2002, the Tricolor ship collided the Kariba portcontainer because of the fog and of the human errors. Later, the Tricolor wreck was collided by other ships: Nicola (16/12/2002), Vicky (January 2002), Berger Smit (January 2002). The last one produced a 1000 tones oilspill which polluted the coasts belonging to France and Belgium. The financial loss was of more than 100 million dollars.

To conclude, the consequences of the oilspill

accidents are severe and consist of fatalities and of huge financial losses. Modern instruments are necessary to prevent, to manage and to minimise the consequences of such accidents.

Virtual Reality application for a crisis management model

The decision making process in a crisis ongoing event must be based on accurate and reliable data. Predictions can be made using parameterized models and modern visualisation instruments such as Virtual Reality.

There were studied several solutions regarding a virtual world which is created in a specific geographical environment and which contains different types of virtual objects: static, mobile, dynamic and instruments.

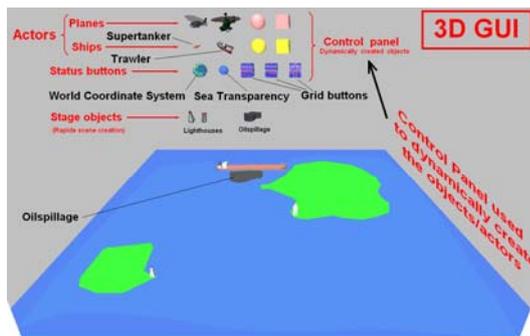


Figure 1 – A first approach in the design of a virtual world employed ECMAScript to model an oil spill scenario

Figure 1 presents a first approach in the design of a virtual world. This approach uses ECMAScript and it presents a cube which contains the “stage” of the event. This world is populated with virtual objects which are handled by the use of a system of axes. Figure 2 presents two such virtual objects.



Figure 2 – Virtual objects handled by the use of a system of coordinates

Figure 3 presents a perspective of the event as it can be seen from the main bridge by the captain and by the navigation crew.

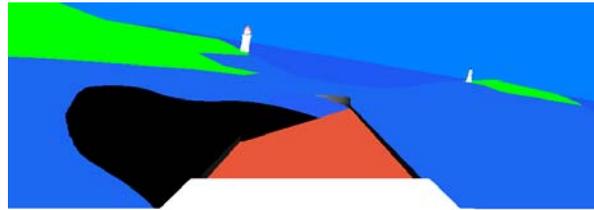


Figure 3 – Perspective from the bridge

Figure 4 presents the final solution which uses Java programs to handle the events. The elements of the scene are:

1. buttons employed to change the textures on the panels;
2. sphere which presents the general location of the scene;
3. geographical information: relief, buildings, etc (static object type);
4. air objects (mobile object type);
5. ship objects (mobile object type);
6. oilspill (dynamic object type).

The 3D VR buttons and the equivalent Swing buttons are used to operate the application. The panels are used to present new information inside the virtual world.

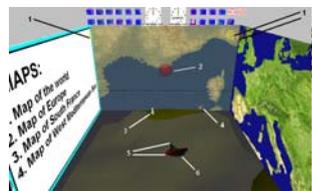


Figure 4 – Java solution employed to present the virtual world



Figure 5 – Virtual instrument

Figure 5 presents a virtual instrument used to evaluate the distances and the extents of the oil spill. There can be also noticed the collision between the two virtual ships, the virtual chopper and the oil spill.

To preserve data consistency, a database was designed to store the hierarchy: scenarios, events, properties.

Conclusion

According to the national law and to the international directives, advanced studies and models are required to predict, to avoid, to manage and to decrease the impact of the crises.

Oil spill accidents have serious consequences and modern instruments are required to

model the different aspects of such events. The applications based on Virtual Reality graphics offer important facilities regarding the data visualisation as a support for the decision making process during the on-going crises. The results of the studies consist of more than 12000 computer code lines dedicated to the Virtual Reality worlds, ECMAScript and Java programs. Some of the results are the outcome of the LASCOT ITEA project. The application can be easily modified for other types of crises being a versatile instrument, synchronous with the trend in the actual knowledge based global society.

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